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Food habits of the white-tailed deer, Odocoileus virginianus Boddaert, in Boone County, Iowa

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FOOD HABITS OF THE WHITE-TAILED DEER, *ODOCOILEUS VIRGINIANUS* BODDAERT, IN BOONE COUNTY, IOWA

by

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INTRODUCTION

The estimated number of white-tailed deer in Iowa increased from 1,650 in 1947 to 6,353 in 1951 (Speaker, 1951), and the actual numbers may be considerably higher (Sanderson, 1950). This increase may lead eventually to two distinct problems as stated by the Conservation Commission of West Virginia (1949, pg. 65) they are "First, damage to crops in agricultural sections; and second, damage done to winter deer range by overbrowsing". That the Iowa State Conservation Commission recognizes the problem raised by this increase is evidenced by the issuance of the following statement (Iowa State Conservation Commission, 1949, pg. 166):

> "The deer populations in Iowa are increasing and have spread over the entire state. There is some complaint of deer damage in certain localities and legislation is needed to provide measures to control populations".

Complaints from the Ledges State Park area of Boone County started as early as 1935, two years after the first deer were released from the park enclosure. No study of that damage was made except verification by Conservation officers that it was occurring. According to E. B. Speaker (1951), Superintendent of Biology, Iowa State Conservation Commission, this seems to be the case in general, with no detailed study carried on anywhere in the state. This

investigation, therefore, was an endeavor to find what native and cultivated plants were utilized by the deer, the extent of utilization, the type of damage done, and the time in the life of the plant at which it occurred. Because of Iowa's agricultural nature, special attention was given to the utilization of cultivated species.

REVIEW OF LITERATURE

The general food habits of deer are quite well-known and Atwood (1941) has compiled a 15 page list of food plants mentioned in other articles. The problem is complicated by the fact that palatability ratings of various foods differ with the location (Research Committee Utah Big Game, Livestock, and Range Relationship Project, 1950). While this is possibly due to depletion of favored foods in some places (Martin, Zim and Nelson, 1951), even within a small area deer may show a marked preference for plants growing in a certain portion of a field (Swift, 1948). Food habits of deer are of interest to both forester and wildlife manager, who must cooperate to see that the deer population is as high as possible to meet increasing hunter pressure, but must also maintain it at a level which is compatible with browse production, forest reproduction, and the agricultural pursuits of the locality (Tripoensee, 1948). Problems created by over populations of deer are widespread throughout the United States. At present at many places in the north, or in the mountainous regions of the west where snow may reduce the range to one-fourth or less of its summer extent, starvation conditions

exist. Malnutrition losses for certain herds of 50 - 60 percent in Texas (Taylor and Hahn, 1947), 50 percent in Oregon (Cliff, 1939), 20 percent in Utah even in mild winters with supplementary feeding (Doman and Rasmussen, 1944), and losses in Minnesota which exceed numbers taken by hunters (Fredine, 1940) are indicative. Such conditions lead to studies concerning methods of producing more browse within reach of deer (Cook, 1939; and Krefting, 1941), studies of digestive capacities (Forbs and others, 1941), winter feeding (Doman and Rasmussen, 1944), and damage to forest reproduction (Hough, 1949).

In addition to damage from overbrowsing under starvation conditions, excessive populations of deer also lead to crop damage. Some states have met this problem by paying damage claims. In 1947, Maine spent about $60,000.00 in this way and it was estimated that the total value of crop damage, investigations, and repellants was about $200,000.00 in 1948. These damages have led Maine to experiment with various methods of control, the most promising of which seems to be the use of repellants (Powell, 1949). In the long run, however, it is probable that the problem can be met only through control of herd size (Bump, 1949).

HISTORY OF DAMAGE AND CONTROL AT THE LEDGES

The deer at the Ledges presented a problem as early as 1935, when a herd estimated at more than 50 animals had developed from 35 deer released from the park deer range in 1933 and 1934 (Material in this section from Hendrickson, 1951, and Salinas, 1948). Because the presence of this herd resulted in some complaints of crop damage, in February, 1935, the Iowa State Board of Conservation moved to reduce the herd and the one at the Backbone State Park. Between 1936 and 1938, over 40 deer were trapped and restocked in various parts of the state and an additional 11 were shot. No more removals were made until 1941 and 1942, when 10 deer were trapped and moved to other parts of the state and 5 were killed and sold. In August of 1942, a group of farmers met at the Ledges and discussed the situation with Mr. Stiles, Chief of Fish and Game Division of the Iowa State Conservation Commission. It was estimated that 500 deer were in the area, damage was affirmed, and the meeting was publicized by the Des Moines Sunday Register. After that meeting the Conservation Commission formed plans to reduce the herd by shooting and professional hunters were hired to do the work. News of the crippling loss reached the public and met with state-wide disapproval so severe that

the project was discontinued. Instead deer were offered to anyone who could provide proper conditions for them and 21 deer were disposed of in this way in the spring of 1943. Because this method of disposal proved unsatisfactory, in the fall of 1943, several Conservation officers were called in after wider publicity, and from December, 1943, to February, 1944, 67 deer were shot and given to state institutions, and an additional 20 trapped and restocked in other counties. No deer were left in the Park enclosure, which was partially dismantled, and subsequent winter feeding consisted only of placing baled alfalfa in fields below the custodian's home to attract deer for the public to see.

At the time of this study the Conservation officer of Boone and Story Counties, Warren Wilson, stated that he had received no complaints of crop damage from the Ledges area in the 5 years that he had held the position. However, that the problem had arisen in other parts of the state is evidenced in a statement by the Iowa State Conservation Commission (1951, pg. 178):

> "The deer population is growing fast and is becoming a problem in many parts of the state. Legislation is needed to give the Commission authority to control the population by some means".

THE INVESTIGATION

Research Area

The investigation was carried on south of the city of Boone, and slightly south and east of the center of Boone County. The area was approximately 6 miles long and 2 miles wide and included all of the Ledges State Park lying east of the Des Moines River which formed the western boundary of the research area. The eastern boundary, really poorly defined, was considered to be the extent to which deer damage extended eastward into the farm land. Parts of two townships were included: Worth Township, tier 83 N., range 26 W., sections: 9, 10, 15, 16, east half 17, 21, 22, 27, 28, east half 29, 33, and 34; and Douglas Township, tier 82 N., range 26 W., sections: west half 2, 3, 4, southeast quarter section 5.

The topography is quite precipitous, with level farm land lying some 200 feet above the river bottoms. Valleys run north and east from the river as much as 2 miles or more, but all the creeks are intermittent with the exception of Reese Creek. The soil is entirely of glacial origin and primarily of three types, all of which are rather unsatisfactory as farm land. (The above and much of the following comes from Stevenson and Brown, 1924).

Sarpy silt loam lies on the flood plain, which averages about one-fourth mile wide and is subject to overflow and poor drainage. Where uncultivated, this soil is forested with oak (Quercus spp.), maple (Acer spp.), elm (Ulmus spp.), sandbar willow (Salix interior Rowlee), cottonwood (Populus deltoides Bartr.), and walnut (Juglans spp.). Although this soil needs organic matter and nitrogen, the corn yields are very good when not drowned out, and farmers consider this land worth cultivation if one crop can be harvested every 2 or 3 years. These persistent attempts and failures, linked with the secluded nature of the fields, produce abundant winter forage for the deer either in waste corn or in corn not considered to be worth harvesting.

On the slopes above the river bottoms lies the steep phase of the Clarion loam, which is exposed along valleys for as much as 2 miles in places. The topography where this soil is found is steep to precipitous and the nature of the soil, which contains much fine gravel, creates serious erosion problems where farming is attempted. It is quite productive and makes excellent blue grass pasture, but where overgrazed need for protection from erosion is obvious. In general, in spite of its productivity, it is of little agricultural significance and probably is best managed where allowed to remain in

natural forest which consists of red oak (Quercus borealis Michx.), bur oak (Q. macrocarpa Michx.), basswood (Tilia americana L.), maple, hickory (Carya spp.), and walnut. Under these conditions it produces abundant browse for deer, but when pastured much of the tree reproduction is destroyed and it acquires a park-like nature which provides little winter deer forage.

On the ridges above the Clarion loam is Conover silt loam which was originally forested with white oak (Quercus alba L.), red oak, hickory, ash (Fraxinus spp.), elm, maple, and some walnut. Known to the farmer as "white oak" soil, it is less productive than the Clarion loam, needing lime, phosphorus, and organic matter, but it is more heavily farmed because of its more moderate topography.

Bounding the Conover loam to the east is the rich Carrington loam, some of the best soil in the county, and the most extensive type. The topography lends itself to farming, and few trees are found. This causes it to be little used by deer which tend to stay in the protection of the forests and valleys nearer the river.

The eastern boundary of the Conover silt loam, or "white oak" soil, can therefore be considered roughly to be the eastern limit of the study area.

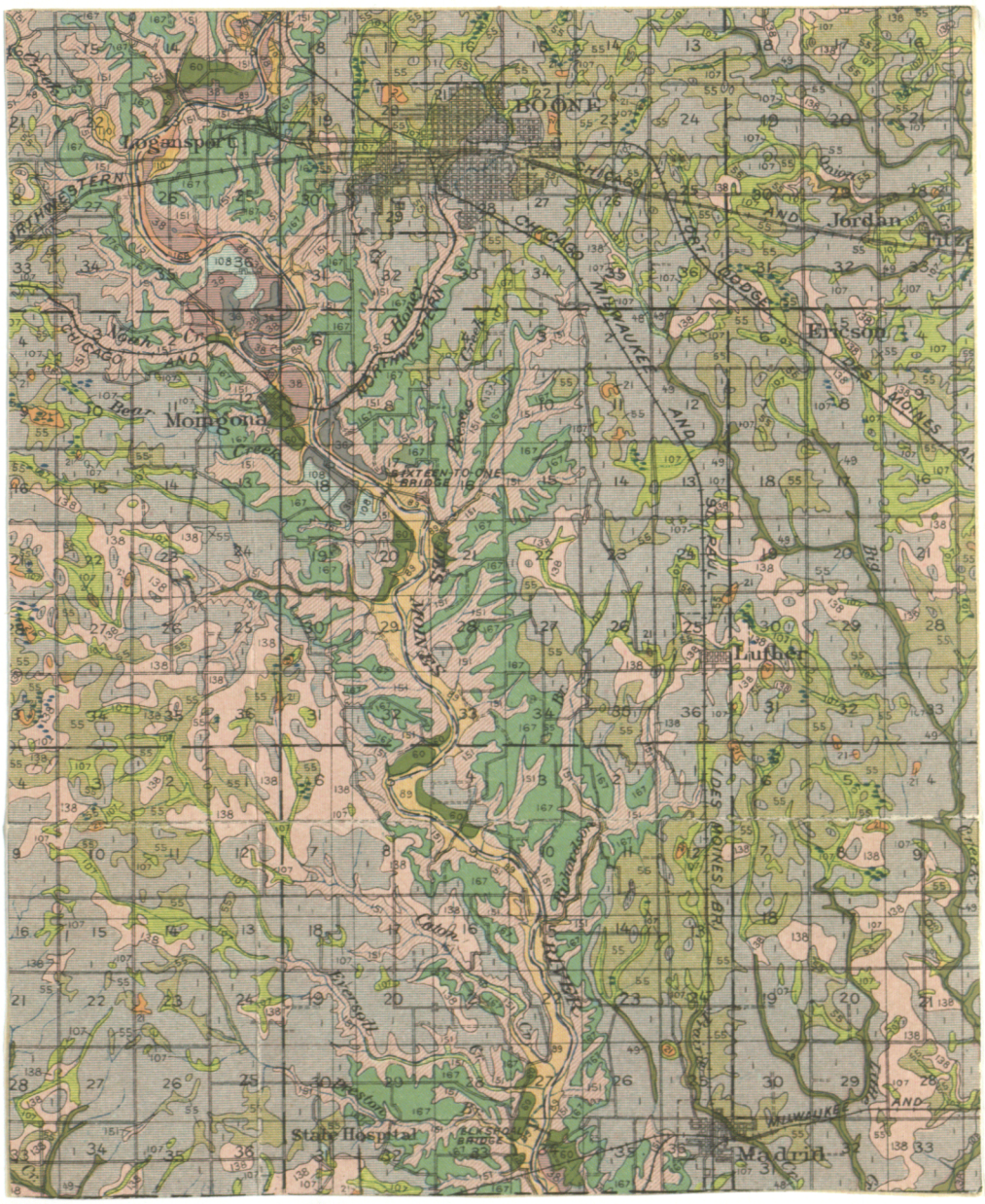

Plate 1. Soil Map of the Research Area.

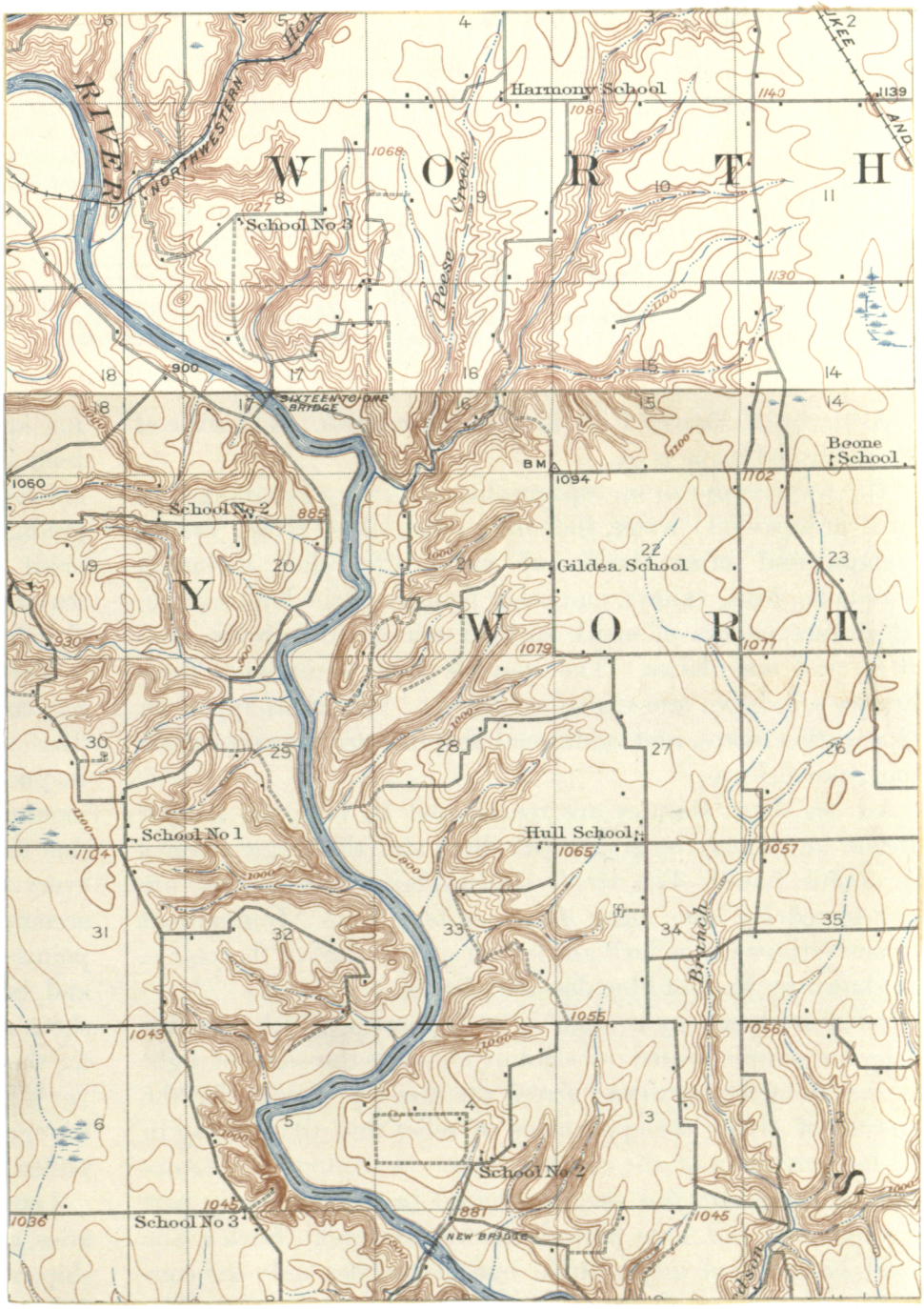

Plate 2. Topographic Map of the Research Area.

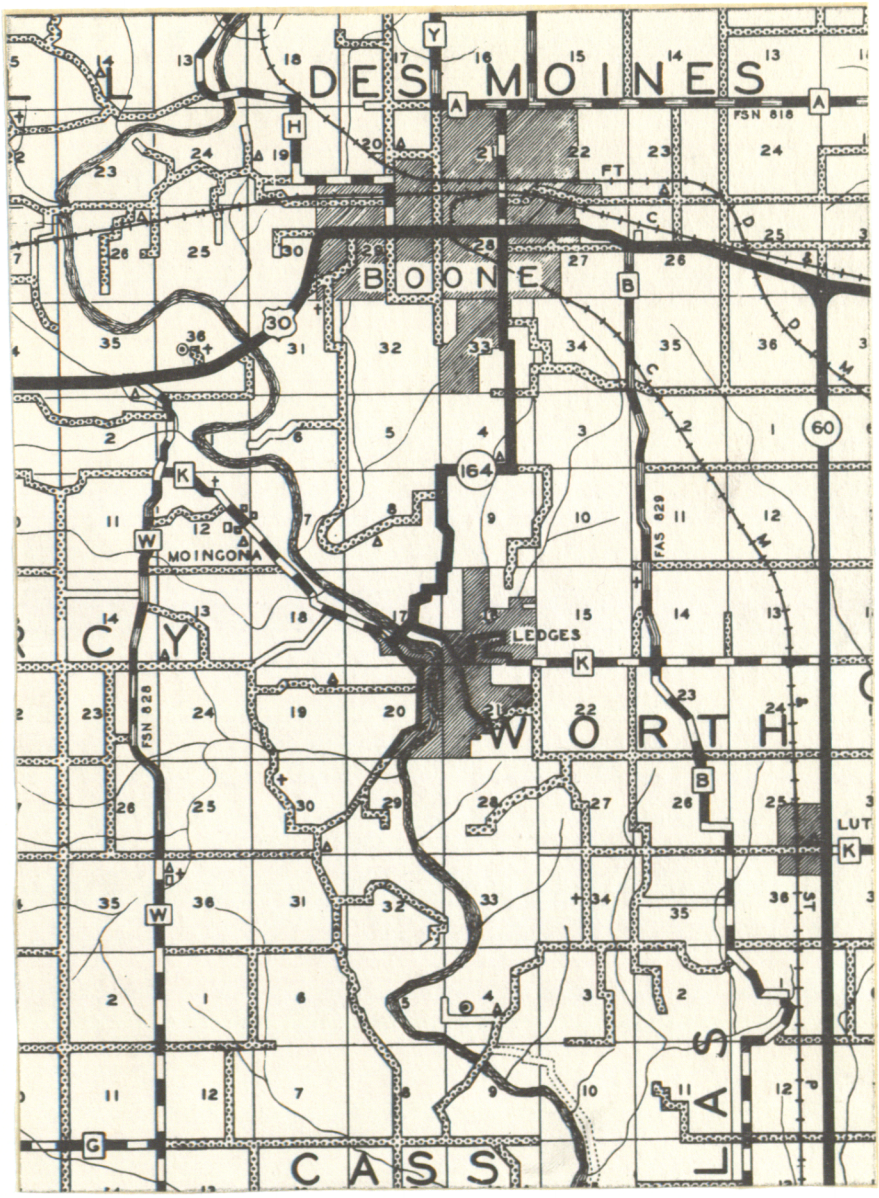

Plate 3. County Map of the Research Area.

Movements

Winter

During the winter quarter of 1950, each Saturday was spent on the area to become acquainted with it, and to study the movements of the deer as indicated by the trails in the snow and by the bedding down places. The Des Moines River was frozen and had a rough surface of melted snow, and it was discovered that the deer were crossing it in large numbers in the Park area from Peese Creek to the first bluffs lying near the river below it, a distance of about one-half mile. The river bottom-lands on both sides of the river in this area were well-wooded with sandbar willow and cottonwood. The former, especially, furnished both excellent cover and abundant browse. The land rose gently from the river to three alfalfa fields in which the Park Custodian, Merle Jones, frequently placed baled alfalfa to encourage deer to come into the open. From those fields the deer entered the valley known as Walking Fern Hollow and then the old 40-acre deer pen which still was fenced sufficiently to funnel the deer out a narrow gate-like opening at its north-eastern corner. The deer then moved into hazelbrush (Corylus americanum Walt.) and staghorn sumac (Rhus typhina Torner) thickets, wandered northward and crossed a 40-acre field planted

to prairie grasses. North of this field, and just across the old road leading to the Oak woods picnic ground was an important deer bedding down site. A trail from this area skirted the heads of the valleys and led to a large patch of poison ivy (Toxicodendron radicans L. Torr.), which was the most used natural feeding spot. From there a trail led west down a former road to an old home site where Peese Creek furnished water when not frozen over, and red cedars (Juniperus virginiana L.), served as a windbreak. From there the deer scattered, as indicated by minor trails going north and south along Peese Creek.

About one-half mile south of this first crossing area was a well-defined trail coming from the willows on the west side of the river, crossing the river in a southeasterly direction and landing on a large sand-bar at approximately the south boundary of the park. This trail, the heaviest traveled one in the area, led over one bluff with a corn field on top, which lay close to the river, and then returned to the bottom lands with their waste corn. The trail could be followed for 2 miles from the place it crossed the river before giving out. From it minor trails led up the valleys and skirted their heads, moving along the wooded edges of fields and crossing the road leading to the game farm slightly above the most

westerly fenced enclosure on the north side of the road. From here the trails led north and finally ended at the bedding place south of the poison ivy patch.

Spring

During the following spring quarter, each Tuesday and Thursday were spent in the area and further studies of deer movement and range were carried on. The deer centered in the area south of the northern boundary of the park. The forested land to the north-east of the park was heavily pastured and offered little in the way of browse. Deer sign became less and less as one moved farther from the park, and in corn fields no sign of tracks were found on the soft ground. Patches of poison ivy showed utilization only by rabbits.

After the river melted, no more deer crossing was observed in the mud along its banks, but the lower trail continued to be used to a lesser degree.

It was during this period that winter utilization of browse was studied and also more comprehensive farmer interviews were made.

The change from browse to early grasses and forbs was noted to occur early in March as soon as the snow exposed green growth. This change was marked by a change in consistency of the deer droppings from hard, dry, dark-colored

individual pellets to a soft, lighter-colored, single mass, which continued to be typical of the droppings throughout the summer (Plates 4-7).

Heavy snows in March, the deepest of the year, cut off the deer's supply of green food and it was at this time that a relative of the park custodian noticed deer browsing on the cedar trees in the park. This is the only instance of this known to the writer and no recent browse marks were found on any cedars in the area.

Summer

During the summer session the writer lived at the Ledges State Park and carried on detailed studies of crop damage. The deer shifted their range into the northern part of the study area and little or no sign was found in that part of the winter range lying along the river to the south. This may have been because the bean fields to the north were better sheltered and farther from human habitation than the bean fields in the south, and the land along the river was planted to corn which was not used as food until it silked out.

Plate 4. Fall and winter scats.

Plate 5. Fall and winter scats on 9" x 12" clipboard.

Plate 6. Typical summer scats.

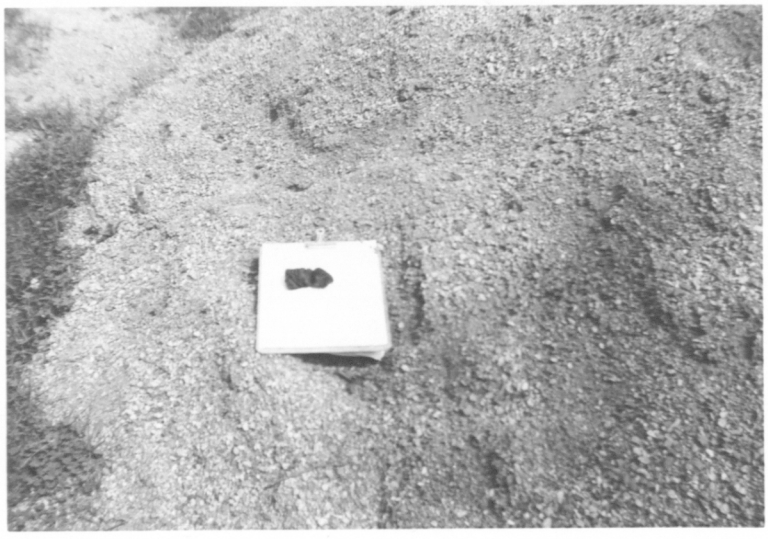

Plate 7. Summer scat on 9" x 12" clipboard.

Census

In an attempt to correlate crop damage to deer numbers, a census was carried on which combined a study of road crossings and numbers of deer seen. The gravel road which ran south for one-half mile from the east entrance of the Ledges, turned west toward the game farm, and then ran north past the custodian's home, crossed the trails used by the deer moving north and south and also crossed those used in moving into the park from the west side of the river. This road proved to be of greater help in determining the amount of movement than it did in determining numbers, because there was no check on how often it was crossed by an individual deer.

Difficulty lay in that tracks were easily seen only soon after rains or at other periods when the ground was moist, as the gravel quickly dried sufficiently that the deer left little evidence of crossing. These counts showed clearly the break-up of the herds at fawning time, when counts dropped from 63 on April 4 to 4 on May 3.

Warren Wilson, the Conservation officer of Boone and Story Counties, estimated that there were 100 deer in Boone County. The writer estimated that from 35 to 40 of these deer were concentrated in the 12 square-mile area

studied on the east side of the river. This estimate seems reasonable when it is considered that the Ledges is the point of origin of the deer, that its 1,000 acres provide much more winter browse than the pastured areas around it, and that it is also comparatively safe from poachers.

Deer were seen on every trip to the area during January, February, and March. The largest herd seen was 7, composed of 1 buck which did not lose its antlers until late February and 6 deer of undetermined sex, including 2 which were crippled. This herd was seen several times within a 3-mile area from the park south through the river-bottom corn fields. The greatest total number of deer seen per day was 9, seen in January. These numbers do not agree well with the largest estimates, 30 - 50 in a herd, given in some farmer interviews, but are believed to be a more accurate indication of actual numbers, and do agree with numbers of deer seen by the majority of farmers.

Winter Foods

Winter utilization of forest browse

While the deer did not stay strictly on the trails through the forested areas, they did so more than in the

glades and fields at the forest's edge. This resulted in a comparatively concentrated use of the browse species bordering the trails and offered an opportunity for investigation of preferred species. In this study of trailside browse, 0.025 acre quadrats were used because of the large number and diffuse nature of the plants. This area quadrat, 3.3 feet on a side, lent itself nicely to percentage sampling in areas of unknown size because distances could be accurately measured in relation to the quadrat by merely increasing the length of one's pace to approximately 40 inches. Randomness was assured by use of random numbers from Snedecor (1946). These numbers were presented in columns of five figures as follows:

4 6 3 5 4
3 8 9 1 5
9 4 1 8 5
1 4 9 6 1
2 1 9 0 5

In taking a 5 percent sample of browse along a trail, the first number in each figure was used and a sample was taken in each 10 paces, alternating on first one side of the trail and then the other. This gave one sample per side in each 20 paces, totaling 5 percent. As an example, with the figures above, from the starting point 4 paces were taken, a sample studied, and 6 more paces taken to complete the unit of ten; then 3 paces, a sample on the

opposite side of the trail, and 7 paces to complete the unit; 9 paces, sample, 1 pace.

If it were desirable to take only a 1 percent sample, the first two numbers in the column were utilized and a sample taken on both sides of the trail in each 100-pace unit. Example: 46 paces, sample on both sides, 54 paces; 38 paces, sample, 62 paces.

The investigation was carried on in the second week in May partly to insure that all winter browse was included, but mainly so that leaves would be present to simplify the identification of the species. There was a period of about 2 weeks during which the leaves were large enough for identification, but still did not obstruct browse marks. No attempt was made to compute the weight of browse taken and no consideration was made of the number of times an individual plant may have been browsed. The investigation was to determine the percent of available plants browsed and the preferred species.

A total of only 8 percent of all woody species showed browse sign even along these heavily used trails. This, of course, included species seldom taken by the deer and others very attractive to them. No evergreens were taken, and only 3 percent of the iron wood (Ostrya virginiana (Mill) Koch) showed browse marks. Such thorny plants as the gooseberry (Ribes missouriense Nutt.) and the honey

locust (Gladitsia triacanthos L.), showed no utilization in this survey, but the rose (Rosa spp.) showed use in 2 percent of the occurrences. The most desirable browse species from percentages showing browse were red-osier dog wood (Cornus stolonifera Michx), 17 percent, box-elder (Acer negundo L.) 25 percent, black cherry (Prunus serotina Ehrh.) 26 percent, oak 30 percent, linden 50 percent, and maple 50 percent.

While a large percentage of both the linden and maple reproduction shows browse sign, little damage was done as, generally the plants showed only one browsed branch and the amount taken appeared to be only an inch or two long. No hedged trees appeared along these forest trails as they did in some cases in open glades and along fences in cleared land.

Winter utilization of browse in clearings

From the percentages of plants taken in clearings it was evident that deer preferred to do much of their feeding in open glades at the edges of the forest. There hazel brush, staghorn sumac, red-osier dogwood, and poison ivy were the most numerous species. The hazel brush showed little use. The dogwood, while attractive to the deer, was not browsed close and the slender branches taken could

have formed only a small percent of the deer's diet. The sumac and poison ivy appeared very attractive to the deer and both were studied in detail.

The patches of sumac (Plate 8) were small enough that 100 percent counts could be made in the areas studied. To insure accuracy a string was placed around the patch and lifted over each sumac plant as it was counted. In this phase of the investigation, which was carried on the first week in April, most of the plants showing browsing were between 18 inches, about the minimum size present, and 30 inches in height, but taller plants were taken to some extent. No plants were observed to have been taken which ended in a clump of seeds, or in a spike from which the seeds had fallen.

Four patches of sumac were studied. Two were in the field east of the Oak Woods picnic grounds of the Ledges State Park, which was used as a bedding down area. One of these showed 52.5 percent of the plants browsed, while the other about 100 yards distant showed only 14.8 percent. The same situation presented itself in the southern patches where one showed 74.7 percent use and the other 47.5 percent. This seemed to indicate that while the deer were not on well-defined trails in either of these clearings, there were portions of them through which it was their

Plate 8. Typical patch of sumac.

Plate 9. Patch of poison ivy.

habit to move. Also the variation in use of plants in the same clearing tends to indicate, as does the light use of forest browse, that there is an abundance of food available. Only the first inch or two of stem was taken as was the case in all instances of browsing, although for several inches further down the stem remained of such consistency that it readily snapped off. After the sumac leafed out only two instances of browsing were noticed. This agrees with Hill (1946) who placed sumac on the unpalatable list of deer foods during the spring and summer, but on the palatable list during fall and winter.

The patch of poison ivy investigated was the one mentioned in the discussion of deer movement (Plate 9). It was slightly over one-half acre in area and was quite dense, with from one to six or seven plants per square foot. Most of the ivy was from 1 to 2 feet tall, but in some places it reached 3.5 feet or more in height. Two trails converged upon it and it was thoroughly dissected with minor paths, indicating its importance as a feeding place. Studies were made both of ivy along the paths and that in the patch in general. Because the large number of plants made a total count impossible, 0.025 acre quadrats were studied. In the third week in April a 5 percent sample was taken along the paths and a 2 percent sample of the entire patch. The method employed along

the paths was the same as that discussed under forest browse, but the samples of total use were taken along transects running through the patch. The patch was divided into sections of 5 paces (16.5 feet) and one random transect was walked in each. Along this transect a 10 percent sample was taken.

An average of 18.3 percent of the plants along the paths showed browse while 17.0 percent were browsed in the patch as a whole. This indicates that in addition to using the dissecting paths, the deer freely left them to browse. Variation in movement along the paths was indicated by differences in ivy utilization, which ranged from 12.5 percent along the least traveled to 36.2 percent along the most traveled. Between different parts of the patch, utilization varied from 7.0 percent in one transect to 36.2 percent in another. No use was observed after the poison ivy leafed out, although it was checked occasionally throughout the period spent at the area.

Winter utilization of corn

No intensive investigation of winter corn consumption was carried on because the little time available for research in the winter was used in becoming acquainted with the area and in observing the movements of the deer. The utilization of corn as presented below is based upon

observations of deer seen feeding, tracks in corn fields, and the importance of deer trails.

Waste corn was probably the most important single source of winter food. The main deer trail from the west bank of the Des Moines River, the most heavily used trail in the research area, led to the river bottom corn fields south of the Ledges State Park, and deer were frequently seen feeding there. Shortly after a fresh snow those fields were criss-crossed with tracks as though a herd of hogs had been foraging in them. As no attempt was made by farmers to salvage any of the corn remaining in these fields after harvest, the feeding by deer hardly could be considered damage. Damage did occur in fields where the corn was left standing until late into the winter or in which it was cut and shocked. One field of shocked corn, lay above the heavily used bottom land fields. Here the many undamaged ears exposed on the outside of the shock indicated that pressure on this source was not great.

Winter utilization of hay

During farmer interviews one farmer complained that deer were damaging a clover hay field some distance behind his home. According to him, the clover stubble was being browsed to the ground, leaving patches as bare as concrete floor. This field was more than one-half mile from any

wooded cover, and, upon examination, no deer sign was found. The patches mentioned were found to be in general only a foot or less in diameter with a maximum of 18 inches (Plates 10, 11). Such spots were not found throughout the entire field, but only in an area about 100 feet square. The drainage in this part of the field was to the north, but the slope was slight. The cause was not determined, but from the lack of sign, it was not believed to be deer. Possibly late fall cutting, or fall pasturing was responsible.

Summer Foods

During the summer the main research concerned the amount and type of damage done to the cultivated crops. Browsing on native forbs, shrubs and trees was also noted (Plates 12 and 13), although no studies of percentage utilization were undertaken. Hill (1946), by stomach analysis, discovered that the summer diet of the white-tailed deer in the Black Hills was composed of 55.6 percent woody browse, 26.4 percent forbs, and 12 percent grasses, mostly (90 percent) blue grass (Poa pratensis).

Plate 10. Unidentified damage in clover field.

Plate 11. Close up of above.

Plate 12. Young black cherry showing browsing.

Plate 13. Cottonwood suckers showing browsing.

Summer utilization of woody browse

It was observed that after the foliage appeared, the palatability of many of the plants changed. Apparently the most outstanding examples of this were the oak, staghorn

Table No. I

Utilization of Browse Species Available the Year Around

Important Foods (In descending order of importance)	Less Important Foods (In descending order of importance)
Poison ivy (Toxicodendron radicans (L.) Torr.)°	Ironwood (Ostrya virginiana (Mill.) Koch)
Sumac (Rhus typhina Torner)°	Mulberry (Morus rubra L.)
Willow (Salix interior Rowlee)	Hawthorn (Crataegus spp)
Dogwood (Cornus stolonifera Michx.)	Crabapple (Malus ioensis (Wood) Britton)
Black cherry (Prunus serotina Ehrh.)	Elderberry (Aralia hispida Vent.)*
Maple (Acer spp)	Hazelbrush (Corylus americanum Walt.)*
Linden (Tilia americana L.)	Wild Grape (Vitis spp)*
Oak (Quercus spp)°	Virginia Creeper (Psedera quinquefolia L.)*
Ash (Fraxinus americana L.)*	Bittersweet (Celastrus scandens L.)*
Rose (Rosa spp)	Raspberry (Rubus idaeus L.)*
Boxelder (Acer negundo L.)	Prickly Ash (Xanthoxylem americanum Mill.)*
Cottonwood (Populus deltoides Bartr.)*	Gooseberry (Ribes missouriense Nutt.)*
	Honey Locust (Gleditsia triacanthos L.)*

Those marked with (*) show increased use in summer.
Those marked with (°) show decreased use in summer.

sumac and poison ivy, which showed a high percentage of browse in winter, but became unattractive to the deer and were almost completely ignored during the summer. Hill (1946) noted this change for sumac and oak, but gave no mention of poison ivy.

Of the thorny plants, the rose appeared to be utilized to about the same extent as in winter, while the new growth of gooseberry, honey locust, prickly ash (Xanthoxylem americanum Mill.), and raspberry (Rubus idaeus L.) was also taken sparingly until the thorns stiffened. These last four plants were not taken at all during the winter. The white ash reproduction in clearings proved very palatable and these young plants were browsed back severely. The same occurred with the black cherry (Prunus serotina Ehrh.) and to a lesser extent with the linden and cottonwood. In some cases the utilization of an individual tree was influenced by its position, and lone trees along fences and other travel lanes proved very attractive to deer (Plate 14).

Summer utilization of forbs

Forbs formed an important but quantitatively undetermined part of the deer's diet. One of the earliest observations of forb utilization was browsing upon jewel weed (Impatiens spp.) at the entrance to Walking Fern Hollow of the Ledges State Park in June. This was a heavily used travel land and browse would be expected to be quite noticeable here. The greatest observed utilization of native forbs occurred after the middle of July,

Plate 14. Lone black cherry hedged by deer.

possibly, because deer movement increased after that period. From the end of April until July 28, no more than 11 crossings per day were noted on the gravel road

Table No. II

Forbs Utilized by Deer

Sweet clover (Melilotus spp.)
Lambs quarters (Chenopodium album L.)
Smartweed (Persicaria hydropiper L.)
Giant Ragweed (Ambrosia trifida L.)*
Jewel weed (Impatiens spp.)
Goldenrod (Solidago spp.)
Goats beard (Tragopogon pratensis L.)*
Wild Lettuce (Lactuca spp.)*
Wood Nettle (Laportea canadensis L.)

Those in which the flowering or fruiting heads taken especially marked with asterisk (*)

around the park and the usual number was seven or less. On July 28, the number rose to 21 and subsequently more deer were seen in cruising the area.

No grass was observed to have been taken, but as Stegeman (1937) points out, such browsing is very difficult to discern and in pastured areas is impossible to tell from farm animal utilization.

Summer utilization of hay

Alfalfa and clover fields provided important browse for deer because of their early availability and

palatibility. Deer were frequently seen in alfalfa fields and some farmers reported seeing the same numbers in their fields morning and evening. This indicated a habit on the deer's part to remain in a limited area. During May, June and July, these fields were frequented by does and their fawns, especially where such fields adjoined woods. This abundant supply of food helps to explain the low utilization of native forbs during this period. No farmers complained about deer damage from this use partly because alfalfa is not an important money crop, and partly because they enjoyed watching the deer. One farmer stated that every night when the river was high three or four deer entered his small alfalfa patch to browse and that when the chores were done he sat in the window and watched them until dark.

Summer utilization of oats

As far as could be discovered oats were not utilized as food, although they did serve as bedding cover before they were cut. (Plates 15-18) This bedding provided the only complaint concerning deer damage in oat fields, in that it matted the oats and caused the harvesting machine to miss some of them as it passed. The writer found that few heads of grain were missed, but many of them must have

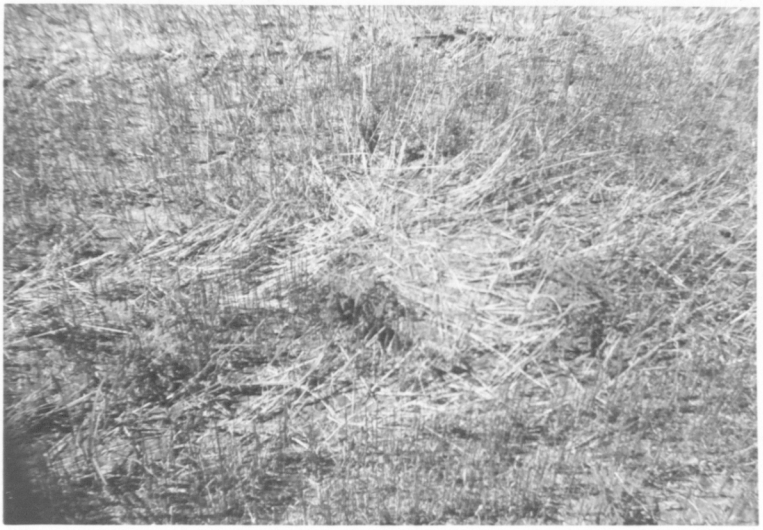

Plate 15. Deer bed in oat field.

Plate 16. Deer bed in oat field.

Plate 17. Deer tracks through field of shocked oats.

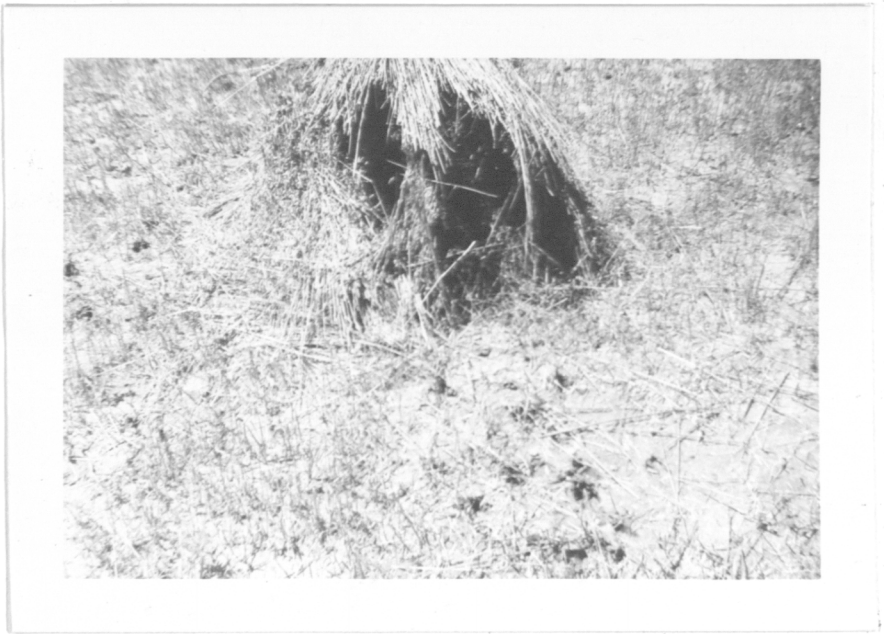

Plate 18. Deer tracks around undamaged oat shock.

been cut extremely short and this could cause their loss if bundled and shocked instead of combined. Unless the deer bedded in the fields regularly little damage could be attributed to this cause, but the beds are so obvious that they brought the farmers' attention to the little damage done.

Summer utilization of soy beans

In the study of soy bean damage each field was first examined by walking the row nearest the forest, as every soy bean field in the area was bounded on at least one side by woods. In most fields from four to eight rows were planted entirely around the outer edge with the idea of harvesting them first to provide an area by which wagons and harvesting equipment could have easy access to the rest of the field. This practice helped in percentage sampling of damage near the woods by presenting a solid row (the "wood-row") instead of merely row ends. It was hoped at first that the percentage of beans taken in the wood-row would form some sort of index from which total damage to the field could be estimated, but this did not prove to be the case, as woodchuck (Marmota monax L.) damage was often present near the woods. As the succulent nature of the bean stems causes them to snap clearly off, beans browsed by deer look the same as beans taken

by woodchucks. This caused some confusion until the writer stopped totaling the rows immediately adjacent to the forest with the rest of the field. Deer damage to bean fields usually was scattered through the entire field, or at least for a considerable distance from the woods, while woodchuck damage centered in the wood-row and was confined almost entirely to the first four or five rows. No deer damage was discovered in any field, however, which did not also show it in the wood-row. Tracks helped in determining the cause of damage, but deer tracks made under dry conditions were easily erased by even a light rain and woodchucks left no tracks unless the ground was very moist.

Fields which showed sign of damage were sampled in much the same way as was the poison ivy. Fields were divided into ten, 20, or 50-row units according to their size and the row studied was chosen by use of random numbers. For each field the number of plants per normal pace was determined, and in sampling a row the beans damaged and total paces taken were recorded. Later the total number of beans in the sample was computed from the beans per pace, and the percent of damage was figured. Damaged beans were considered to be those either taken entirely when young, or those from which the tops were taken, resulting in lowered production. Damage of this

type varied from 0 to 0.7 percent for entire fields, and from 0 to 9.0 percent for wood-rows.

Beans were found to be browsed by deer from the time they broke the ground until they ripened and dried

Table No. III

Percent of Damage in Various Rows of Typical Deer Damaged Fields

Field I (Total Damage 0.3 Percent)		Field II (Total Damage 0.7 Percent)	
Row	Percent Damage	Row	Percent Damage
Wood-row	5.0	Wood-row	1.9
5	3.0	5	2.9
10	2.2	10	2.7
20	1.9	20	1.3
30	0.0	40	0.5
40	0.7	60	0.0
50	0.4	80	1.6
60	0.3	100	0.0
70	0.6		
80	0.5		
90	0.0		
100	0.1		
110	0.7		
120	0.0		
130	0.0		
140	0.0		

in the fall, but were most susceptible to damage until they reached a height of 12 to 14 inches. During the time they had only two leaves, browsing resulted in the loss of the entire plant (Plate 19) and prevented all further growth. This damage was best studied soon after it occurred, but when this was impossible the stumps of

Plate 19. Young beans with tops nipped off by deer.

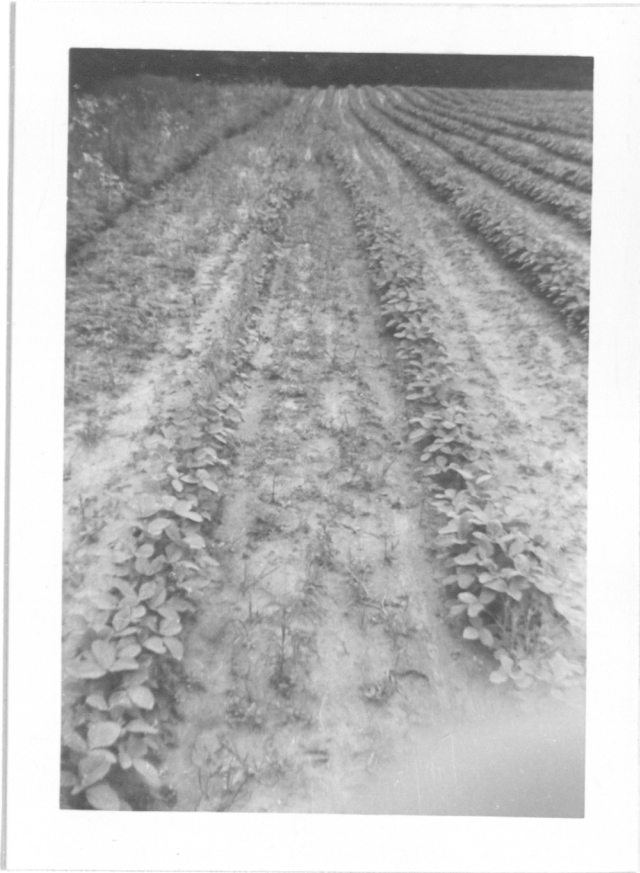

Plate 20. Beans browsed after side branches had developed.

the destroyed plants were seen for 3 or 4 weeks by merely pushing aside the foliage of the uninjured plants and exposing their bases. When plants which had developed their first side branches were browsed, only the tops were taken and the branches left continued development and bore beans, thus preventing total loss (Plates 20-22). After beans reached 12 to 14 inches in height, browsing resulted only in the loss of leaves (Plate 23), and was believed to affect production very little. A sample section of a row so browsed was later investigated, and found to have more beans per plant than samples from the same row on either side of this browsed section. In the meeting of farmers at the Ledges State Park in August, 1942, reports were made of deer eating bean blossoms (Hendrickson, 1951). The small flowers lie close to the stem, and to reach them the deer would have to push away 4 or 5 inches of foliage. No instances of this were found, the deer apparently preferring to browse only the exposed tips of branches. Neither did the deer seem interested in the pods once they had set on, and plants were found which were browsed almost entirely bare of leaves but were still thickly hung with green pods (Plates 24 and 25). Damage as severe as that illustrated occurred only to a few scattered plants, usually isolated in an area of much deer movement. Plants a few feet away often showed

Plate 21. Recovery of beans browsed after branching.

Plate 22. Appearance of row after recovery.

Plate 23. Older beans showing loss of leaves.

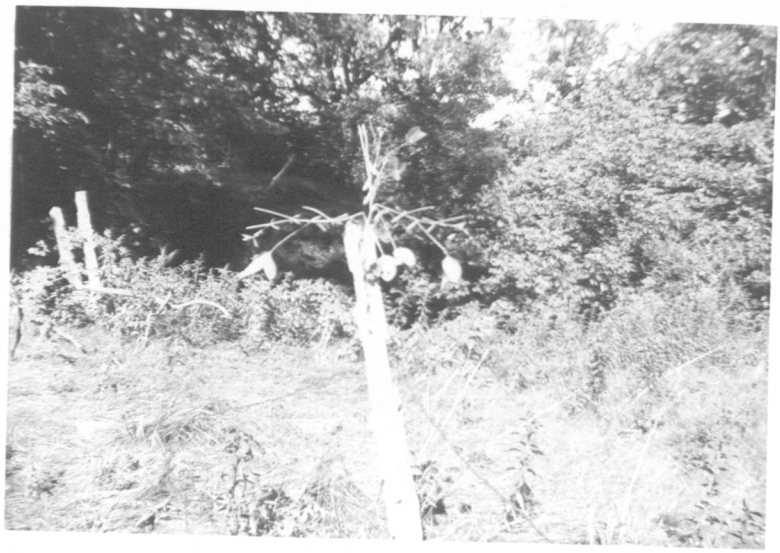

Plate 24. Isolated bean plant browsed almost bare but with no pods taken. (Placed on post by writer)

very little usage. The total percent of beans browsed during the summer was not determined as when only leaves were taken new growth soon covered the loss.

Some farmers stated that after beans dried in the fall deer shattered the pods by running through the field. The writer surprised a buck in a bean field in October and although he ran through rows of beans none were knocked off or shattered (Plate 26). Upon investigation the pods were found to be very tough and firmly attached and even kicking the plants had no effect on them.

Summer utilization of corn

The method of investigating corn damage was much like that used in sampling soy beans. The percent to be sampled varied inversely with the size of the field, and the rows to be walked were chosen by random numbers. The number of ears per acre was computed for each corn field from the distance between hills and the average number of ears developing per hill. This number was used in determining the percent of damage from the sample taken. Damage varied from 0.42 percent ears browsed in the north to no damage in the south of the area. As deer never entered more than five or six rows into any field, the large fields showed a smaller percent of damage than

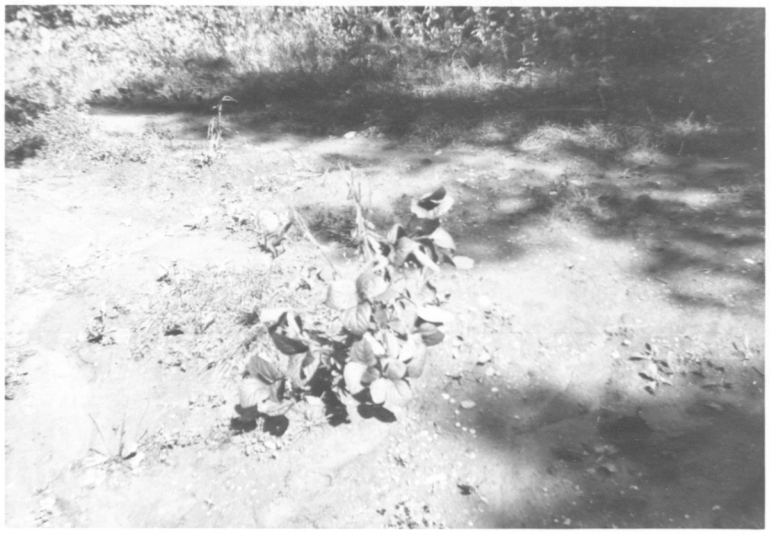

Plate 25. Isolated bean plant heavily browsed, but only leaves taken.

Plate 26. A buck running through these beans did not dislodge any pods or shattering (tracks above center). While there were deer tracks in the field (lower tracks) no beans seemed to be taken.

smaller areas. The damage to the corn was somewhat less than the percent of ears browsed, because some of these ears did develop normally when browsed after pollination and others were not a total loss. Often,

Table No. IV

Deer Damage to Various Size Corn Fields in the Northern Part of Area

Field	Acreage	Percent of Damage
A	1.5	0.41
B	4	0.42
C	4	0.23
D	20	0.17
E	80	0.03

however, smut infected browsed ears (Plate 28) and increased the losses. Corn fields were investigated from the time the corn sprouted. Although deer tracks were seen in these fields, no corn was taken until the ears silked out. At no time were the deer observed to take any part of the corn plant other than the ears and silk (Plates 27 - 29). Cattle, which occasionally broke into corn fields, ignored these parts (Plate 30) and concentrated upon the leaves. After the silk had dried the deer damage ceased until harvest time. While harvesting, one farmer picked and husked the ears from several rows to enable him to get a wagon into the field. Before

Plate 27. Nubbins resulting from deer browsing.
(Unbrowsed ear in center)

Plate 28. Ears above husked.
(Note that three are infected with smut)

Plate 29. Typical deer damage to young ears. Note browsed tips and missing silk.

Plate 30. Cattle damage to corn. Note that leaves are browsed, but ears undamaged.

this corn was picked up it was used heavily by the deer which ignored unhusked corn remaining on the stalks.

Raccoon (Procyon lotor hirtus, Nelson and Goldman) damage, coinciding with the deer utilization, could be distinguished from it by the husking and frequent picking of ears from the stalk (Plates 31 - 33). Occasionally stalks were broken down by the raccoons when they climbed for the ears (Plate 34). In eating the corn deer browsed only from the tips of the ears, while the raccoons, after husking the ear, ate the more developed kernels nearer the base (Plates 32 - 33).

As corn matured many husks were pecked open by birds and later became infested with four-spotted fungus beetles (Glischrochilus quadrisignatus Say). In early damage of that type the peck marks in the husk were clearly visible, but in cases when birds had returned many times the ear was opened to the point that it might be mistaken for one damaged by deer unless closely examined (Plates 35 - 36).

Summer utilization of garden produce

No garden damage by deer was observed or reported during the summer of 1951, although in previous years it had occurred. One farmer told the writer that when deer

Plate 31. Ear husked by raccoon.

Plate 32. Ear removed and husked by raccoon.

Plate 33. Ear husked and partially eaten by racooon. (Posed by writer)

Plate 34. Corn stalk broken by raccoon.

Plate 35. Bird damage to corn.

Plate 36. Bird damage to corn.

were more numerous they had entered his garden and eaten beet tops, and in some instances even dug up the beets. After the beets had been destroyed, the deer attacked carrot tops. Under these conditions sweet corn was taken also, but raccoons were the worst offenders in that respect. Damage by deer is held at a minimum by the proximity of house and garden, especially when the farm has a dog. Utilization of apples by deer was limited to windfalls.

CLIMATE DURING INVESTIGATION

Early in June farmers told the writer not to expect to find much damage until toward the middle of July, when the grasses and other natural foods would become dry and dusty. Then, they said, the deer would move into the cultivated fields and eat the farm crops. As the summer of this study had greater precipitation than average (U. S. Dept. of Commerce, 1951), the conditions predicted

Table No. V

Climate During Summer, 1951, Compared to Average

	1951		Average	
	Precipitation	Temperature	Precipitation	Temperature
June	6.11	65.2	4.80	69.5
July	4.45	72.1	3.66	74.5
August	6.21	70.5	3.59	72.2

never occurred. The natural deer foods never became dusty and unpalatable, and no great seasonal variation in crop damage was noted. Browsing on beans occurred from the time they broke the ground until the leaves dried in the fall. Corn was not used until it silked and in general not after the silk dried. Garden damage did not occur. One complaint was that after beans had ripened deer ran through

the fields and shattered the pods, causing much damage. Again in this respect the wetter season may have caused the pods to remain tougher and less liable to shattering, as no damage of this type was observed.

In drier years the farmers' observations may be correct, or they may merely have noticed the deers' damage to corn which silks out about the time they mention. Possibly under pressure from a larger herd, damage would be as described, and the present herd is generally conceded by farmers to be smaller than 2 or 3 years previously. Probably the precipitation has some effect on natural foods, keeping them clean and succulent. The relation of climate to food habits of deer apparently has been studied little as nothing is to be found concerning it in the literature. Nothing but conjectures can be drawn concerning its effect without further information.

SUMMARY

1. In 1951 Iowa's deer were about four times as numerous as in 1947 and their damage to crops had created a need for control in some parts of the state.
2. This investigation was carried on in a 12-square mile area centering around the Ledges State Park in Boone County, Iowa, from January through October, 1951.
3. In sampling native browse 0.025-acre quadrats were employed, and investigating damage to row crops random rows were studied.
4. During the winter deer browsed as high as 50 percent of the linden and maple seedlings along trails, but most were only browsed once. A smaller percent were browsed throughout the forest as a whole and, in general, forest reproduction was not injured by deer.
5. Staghorn sumac, poison ivy, red-osier dogwood, and sandbar willow furnished large amounts of winter browse, with 74 percent of the plants showing browse in small patches of sumac.
6. In browsing all types of plants the general practice of the deer was to take only 1 or 2 inches from the tips of the branches.

7. During the spring and summer the selection of many plants changed from that of winter. This was most noticeable in the oak, staghorn sumac, and poison ivy, which were not taken after they leafed out.
8. The change from dry winter browse to moist new growth was discerned readily from moister scat consistency.
9. Alfalfa and clover formed important sources of early green food in the spring.
10. During the summer the deer probably browsed all native forbs, shrubs, and trees in the area, including the thorny ones, but the most important were clover, lamb's quarters, smartweed, giant ragweed, white ash, and black cherry.
11. Soy beans were utilized from the time they broke the ground until the leaves died in the fall.
12. The most significant damage was done to young soy beans, which were destroyed, while browsing on older plants usually resulted only in loss of leaves.
13. The blossoms, green pods, and ripe fruit of soy beans were not molested.
14. In the field most heavily utilized by deer, 0.70 percent of the plants were damaged to the point that seed production was affected.
15. Deer moved freely through the bean fields but did not enter the taller corn for more than five or six rows until the leaves died in the fall.

16. Ears of corn browsed by deer were seldom destroyed completely, but smut often infected such ears and increased the damage.

17. During the summer deer browsed only the silk and young ears of corn, and this damage was limited to the period that the silk was succulent. During the fall and winter only the kernels were eaten.

18. During the winter waste corn in fields furnished one of the most important sources of the deers' diet.

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